What is Claimed Is:

1. An integrated radio frequency ("RF") receiver front end, comprising:

a balun circuit, comprising:

a first inductor;

a second inductor, magnetically coupled to the first inductor, to transform a single-ended signal to a differential signal, wherein the second inductor has a center tap node;

a first capacitor, coupled in parallel to the first inductor, to form a resonance with the first inductor to maximize a gain of the single-ended signal;

a first resistor, coupled in parallel to the first capacitor, to stabilize the gain of the single-ended signal;

a second capacitor, coupled at one end to the center tap node and to AC ground at the other end, to improve the balance between a first half of the differential signal and a second half of the differential signal;

a third capacitor, coupled in parallel to the second inductor;

a fourth capacitor, coupled in parallel to the third capacitor, that together with the third capacitor matches the impedance between a low noise amplifier and a mixer; and

the mixer, coupled to the balun circuit, comprising:

a first transistor having a source, a gate, and a drain, the gate coupled to the fourth capacitor, the source coupled to ground, and the drain producing a first half of a differential signal in current form; and

a second transistor, together with the first transistor, to convert the differential signal from a voltage form to a current form, the second transistor having a source, a gate, and a drain, the gate coupled to the fourth capacitor, the source coupled to ground, and the drain producing a second half of the differential signal in current form.

2. The integrated RF receiver front end of claim 1 further comprising a low noise amplifier, coupled to the balun circuit, to amplify the single-ended signal.

3. The integrated RF receiver front end of claim 2 further comprising an antenna, coupled to the low noise amplifier, to receive an electromagnetic signal and convert it to the single-ended signal.

4. The integrated RF receiver front end of claim 1 wherein the balun circuit includes a mixer bias unit, coupled to the center tap node, to bias the mixer.

5. The integrated RF receiver front end of claim 4 wherein the mixer bias unit includes a second resistor, coupled to the center tap node, and a first voltage supply, coupled to the second resistor.

6. The integrated RF receiver front end of claim 2 wherein the balun circuit includes a low noise amplifier bias unit, coupled to the first inductor, to bias the low noise amplifier.

7. The integrated RF receiver front end of claim 1 wherein the low noise amplifier bias unit includes a second voltage supply, coupled directly to the first inductor.

8. The integrated RF receiver front end of claim 1 wherein the mixer includes

a third transistor having a source, a gate, and a drain, the gate coupled to a first half of a differential signal produced by a local oscillator, the source coupled to the first half of the differential signal in current form, and the drain producing at least some of a first half of an intermediate frequency differential signal;

a fourth transistor having a source, a gate, and a drain, the gate coupled to a second half of the differential signal produced by the local oscillator, the source coupled to the first half of the differential signal in current form, and the drain producing at least some of a second half of the intermediate frequency differential signal;

a fifth transistor having a source, a gate, and a drain, the gate coupled to a second half of the differential signal produced by the local oscillator, the source coupled to the second half of the differential signal in current form, and the drain producing at least some of the first half of the intermediate frequency differential signal; and

a sixth transistor having a source, a gate, and a drain, the gate coupled to the first half of the differential signal produced by the local oscillator, the source coupled to the second half of the differential signal in current form, and the drain producing at least some of the second half of the intermediate frequency differential signal.

9. An integrated balun circuit that receives a single-ended signal, comprising:

a balun to passively convert a single-ended signal to a differential signal;

a resonance forming unit, coupled to the balun, to maximize a gain of the single-ended signal;

a gain stabilizing unit, coupled to the balun, to stabilize the gain of the single-ended signal;

a balun grounding unit, coupled to the balun, to improve the balance between a first half of the differential signal and a second half of the differential signal; and

an impedance matching unit, coupled to the balun, to match the impedance between a low noise amplifier and a mixer to maximize transfer of the passively converted differential signal.

10. The integrated balun circuit of claim 9 further comprising a LNA bias unit, coupled to the balun, to bias a low noise amplifier.

11. The integrated balun circuit of claim 9 further comprising a mixer bias unit, coupled to the balun, to bias the mixer.

12. The integrated balun circuit of claim 9 wherein the balun includes a first inductor and a second inductor where the first inductor is magnetically coupled to the second inductor and the second inductor has a center tap node.

13. The integrated balun circuit of claim 12 wherein the resonance forming unit includes a first capacitor, coupled in parallel to the first inductor.

14. The integrated balun circuit of claim 13 wherein the gain stabilizing unit includes a first resistor, coupled in parallel to the first capacitor.

15. The integrated balun circuit of claim 12 wherein the balun grounding unit includes a second capacitor, coupled to the center tap node at one end and to AC ground at the other end.

16. The integrated balun circuit of claim 12 wherein the impedance matching unit includes a third capacitor, coupled in parallel to the second inductor, and a fourth capacitor, coupled in parallel to the third capacitor.

17. An integrated radio frequency ("RF") receiver front end, comprising:

a balun to passively convert a single-ended signal to a differential signal;

a resonance forming unit, coupled to the balun, to maximize a gain of the single-ended signal;

a gain stabilizing unit, coupled to the balun, to stabilize the gain of the single-ended signal;

a balun grounding unit, coupled to the balun, to improve the balance between a first half of the differential signal and a second half of the differential signal;

an impedance matching unit, coupled to the balun, to match the impedance between a low noise amplifier and a mixer to maximize transfer of the passively converted differential signal; and

a voltage-to-current converter to convert the differential signal from a voltage form to a current form without using a current source.

18 The integrated RF receiver front end of claim 17 further comprising a LNA bias unit, coupled to the balun, to bias the low noise amplifier.

19. The integrated RF receiver front end of claim 17 further comprising a mixer bias unit, coupled to the balun, to bias the mixer.

20. The integrated RF receiver front end of claim 17 wherein the balun includes a first inductor and a second inductor where the first inductor is magnetically coupled to the second inductor and the second inductor has a center tap node.

21. The integrated RF receiver front end of claim 20 wherein the resonance forming unit includes a first capacitor, coupled in parallel to the first inductor.

22. The integrated RF receiver front end of claim 21 wherein the gain stabilizing unit includes a first resistor, coupled in parallel to the first capacitor.

23. The integrated RF receiver front end of claim 20 wherein the balun grounding unit includes a second capacitor, coupled to the center tap node at one end and to AC ground at the other end.

24. The integrated RF receiver front end of claim 20 wherein the impedance matching unit includes a third capacitor, coupled in parallel to the second inductor, and a fourth capacitor, coupled in parallel to the third capacitor.

25. The integrated RF receiver front end of claim 24 wherein the voltage-to-current converter includes

a first transistor having a source, a gate, and a drain, the gate coupled to the fourth capacitor, the source coupled to ground, and the drain producing a first half of the differential signal in the current form; and

a second transistor having a source, a gate, and a drain, the gate coupled to the fourth capacitor, the source coupled to ground, and the drain producing a second half of the differential signal in the current form.

26. The integrated RF receiver front end of claim 17 further comprising a frequency downconverter, coupled to the voltage-to-current converter, to mix the differential signal in the current form with a differential signal produced by a local oscillator to produce an intermediate frequency differential signal that is at a lower frequency than the differential signal in the current form.

27. The integrated RF receiver front end of claim 26 wherein the frequency downconverter includes

a third transistor having a source, a gate, and a drain, the gate coupled to a first half of a differential signal produced by the local oscillator, the source coupled to the first half of the differential signal in the current form, and the drain producing at least some of a first half of the intermediate frequency differential signal;

a fourth transistor having a source, a gate, and a drain, the gate coupled to a second half of the differential signal produced by the local oscillator, the source coupled to the first half of the differential signal in the current form, and the drain producing at least some of a second half of the intermediate frequency differential signal;

a fifth transistor having a source, a gate, and a drain, the gate coupled to the second half of the differential signal produced by the local oscillator, the source coupled to the second half of the

differential signal in current form, and the drain producing at least some of the first half of the intermediate frequency differential signal; and

a sixth transistor having a source, a gate, and a drain, the gate coupled to the first half of the differential signal produced by the local oscillator, the source coupled to the second half of the differential signal in current form, and the drain producing at least some of the second half of the intermediate frequency differential signal.

28. A method for converting a single-ended signal to a differential signal, comprising:

resonating at an operating frequency to maximize a gain of the single-ended signal;

stabilizing the gain of the single-ended signal;

passively converting the single-ended signal to produce a differential signal;

grounding a balun to improve the balance between a first half of the differential signal and a second half of the differential signal;

matching the impedance between a low noise amplifier and a mixer to maximize the power transfer of the differential signal; and

converting the differential signal from a voltage form to a current form without using a current source.

29. The method of claim 28 further comprising providing a bias to the low noise amplifier and the mixer.

30. The method of claim 28 further comprising matching a load of the low noise amplifier with a load of the mixer.

31. The method of claim 28 further comprising providing the gain to the single-ended signal.

32. The method of claim 28 further comprising providing a load to the low noise amplifier.

33. The method of claim 28 wherein passively converting the differential signal to current form includes providing gain to the differential signal.

34. The method of claim 33 further comprising mixing the differential signal in the current form with a signal from a local oscillator to produce an intermediate frequency differential signal that is at a lower frequency than the differential signal in the current form.

35. The method of claim 28 wherein passively converting the single-ended signal to produce the differential signal includes filtering out low frequency intermodulation products from the single-ended signal.